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OCEANOGRAPHY

Science to Explore Ocean Canyons

FANTASTIC DENIZENS OF THE DEEP with whom scientists may soon have more than a nodding acquaintance. From a painting by Albertus H. Baldwin

Miles beneath the ocean's surface are regions which scientists, since the dawn of history, have tried in vain to penetrate. Far down in the inky vastness of these undersea canyons or "deeps" may be the solution of many perplexing earthquakes. Perhaps, too, the ocean's mysterious labyrinths bear secrets which, if revealed, would explain vastly important data on the origin of volcanic disturbances.

These matters considered, imagine how scientists are regarding the news from that notable scientific body, the International Geodetic and Geophysical Union, that the organization has proposed an international cooperative scheme whereby it is hoped to combine vast technical and money resources for extensive study of the ocean's canyons. Meeting recently at Prague, Czechoslovakia, scientists of 25 leading nations pledged their support to the possible epoch-making venture.

According to Commander N. H. Heck, of the U. S. Coast and Geodetic Survey, who attended the conference, if the proposal takes its hoped-for course in practice, three main methods of procedure will be under serious consideration: widespread depth sounding; gravity observations on the surface, dealing

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Science To Explore Ocean

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with structural considerations such as recently were probed with remarkable results by the eminent Dr. J. Vening Meinesz of the Dutch Geodetic Commission; and the spread of seismological stations for earthquake study.

Human imagination can hardly picture the vastness of the submarine troughs. Scientists have dubbed them "the earth's last frontier" because, until very recently, man has been unable to devise instruments capable of plumbing them with any degree of accuracy. Gigantic indeed is the Grand Canyon of the Colorado, but even its breath-taking bigness fades into insignificance when compared with the ocean canyons. The Grand Canyon drops downward for a mile, while the sea canyons are from three to four times deeper. Sometimes they extend thousands of miles in length, making the 217-mile stretch of the Grand Canyon seem puny indeed.

Perhaps the most accessible deep for scientific research is the Aleutian, roughly 1,500 miles long and over 4,000 fathoms, or about five miles deep, and having an indeterminate width. Starting off the coast of Alaska, it parallels the Aleutian island chain, extends over towards Kamtchatka, there joining another great canyon which reaches down past the Japanese islands, thence east to the Philippines; then for the first time breaking into smaller deeps upon reaching the South Sea islands.

The well known Tonga Deep near Samoa likewise seems important for immediate research work, for extensive seismological investigations are being conducted in the vicinity, notably at Apia, Samoa, and at the stations in New Zealand and Australia. Moreover, Pago-Pago, at the Isle of Tutuila, is an American port. So American scientists may well have an active interest in the region.

HOW SOUND TRAVELS from a ship's bottom to sea bottom, "bounces" back, and is timed on the bounce to measure the sea depth

In general, the Pacific deeps are by far the greatest to be found anywhere. The reason, as pointed out by Commander Heck, is unquestionably tied up with the fact that the Pacific is the source of most of the world's severe earthquakes. However, were the United States to enter the world-wide deep investigation picture, American scientists might do well to begin by probing the Atlantic. The

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ENTOMOLOGY

Riddle of Hoppers' Parasites

A new angle in the already complicated puzzle of the cause of sex in animals has been uncovered by the researches of three workers in the U. S. Department of Agriculture, Dr. N. A. Cobb, Dr. G. Steiner and Dr. J. R. Christie. Stated roughly, they have found that crowded quarters, possibly complicated by short rations, tend to produce males, while more room and better living conditions generally tend to produce females, in certain parasitic hairworms that infest the bodies of insects.

Their discovery was the result of an effort to play the old game of the fighting entomologist, turning one small creature against another in man's unending warfare on the devouring hosts that threaten his crops. In the present instance they were trying to find how many eggs of the hairworms a grasshopper would have to eat on his natural diet of leaves, to become so heavily infested that he would die without descendants. An average of less than fifty, they learned, would produce a fatal family of hairworms in the poor hopper's insides. A few less, and the hopper lived, but could produce no offspring.

It was also found that unmated female hairworms laid eggs which hatched in perfectly normal fashion, but that all of the young from these fatherless eggs were females. This was not surprising in itself, for unfathered offspring are common in the lower branches of the animal kindom.

But when these unfertilized eggs were fed to grasshoppers in excessive numbers the worms that hatched from them were all males. When only a few eggs were administered to the victim hoppers, they hatched out females. Intermediate numbers turned out mixed batches of males and females, the proportion of males bearing a fairly constant relation to the number of eggs swallowed by the luckless grasshoppers.

Results similar to those observed on grasshoppers were obtained both in the laboratory and in the field with ants, midges, tea-bugs and other insects and their special genera of hairworms.

Dr. Cobb and his associates suggest that inasmuch as grasshoppers are very abundant and their hairworm parasites even more so, good opportunities for further research into the cause and possible control of sex are offered by this material.

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ASTRONOMY

WILLIAM SNYDER EICHELBERGER

Star Tabulator

The layman is sometimes surprised to find that the chief astronomical work of the United States government is under the Navy Department, in the Naval Observatory. But this can be understood when it is recalled that the whole problem of navigating a ship, away from landmarks, is essentially an astronomical one, depending on the position of heavenly bodies. And in order that navigation may be done most accurately, the motions and positions of these bodies must be precisely known.

The "American Ephemeris and Nautical Almanac" provides this information, and so it, and its little brother, "The Nautical Almanac" are the vade mecums of astronomer and navigator alike. As a conséquence, the Director of the Nautical Almanac occupies one of the most responsible of all astronomical positions. This is the post that Dr. Eichelberger has held with distinction since 1910. In addition to his scientific duties, he has to be something of a diplomat as well, for the corresponding offices of the different leading countries cooperate, each producing part of the material that all the almanacs contain.

Dr. Eichelberger was born in Baltimore in 1865. In 1891 he received his Ph.D. from Johns Hopkins, and in 1898 he joined the forces of the Naval Observatory, where he has remained since. A few years ago the Royal Astronomical Society of Great Britain gave him the coveted honor of their associateship.

Science News-Letter, December 10, 1927

The western horned owl has one mate for life.

MEDICINE

Neutralizes Cancer Virus

Another advance has been made toward the solution of the cancer problem.

Dr. Margaret R. Lewis of the Department of Embryology of the Carnegie Institution of Washington and Dr. Howard B. Andervont of the Johns Hopkins University have just succeeded in establishing that the unidentified organism that causes the Rous chicken sarcoma, can be rendered inactive by means of small quantities of aluminium and calcium salts. The significance of this work lies in its possible application in the treatment of human cancer. An immense amount of research will have to be done before any such result is likely to ensue but these recently learned facts point the way to a new direction for cancer research. If it is found that calcium and aluminium compounds, either given by mouth or injected into the blood stream, will have an adverse effect on cancer in chickens, it may lead to results of great benefit in treating human cancer because these compounds are more or less inert with little capacity to harm body tissues.

"While the primary tumor of this particular type of malignant chicken cancer," explained Mrs. Lewis, "differs in some respects from those found in human beings and higher animals, the secondary tumors or metasteses, as they are called, are similar to the malignant sarcoma of man. The chicken tumor behaves quite as those of other kinds of animals in that it invades the tissue, develops metasteses, leads to the death of the animal and can be transferred by means of transplantation from one animal to another of the same species, though not, of course to an animal of a different species.

"The chicken tumor also resembles certain other diseases in that it is caused by a still unidentified agent that behaves like the so-called filterable viruses responsible for small pox, rabies and encephalitis in rabbits. Many years ago Dr. Peyton Rous and Dr. J. B. Murphy of the Rockefeller Institute for Medical Research found that the causative agent for chicken tumor remained active in a filtrate, a glycerine extract or in the dried material of the tumor itself. It was also established by these workers that inoculation of these agents not only produced the disease but if the animal recovered from the tumor it was more or less immune to further inoculation of the tumor virus."

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CHEMISTRY

Rubber From Coal

By Edwin E. Slosson

Everybody in America who owns an automobile—or rides in one—is concerned by the two recent announcements of the German Chemical Trust. First that synthetic gasoline may be made at marketable prices from coal. Second that synthetic rubber may be made at marketable prices, also presumably from coal. Since we consume more gasoline and rubber than any other people in the world we are most interested in the reported discoveries. They belong to the news to be classified as "important if true."

In both cases the chemistry is correct but the practicality is questionable. It has been known for many years that both processes are possible but it has not yet been proved that they are profitable. I have here in America seen and smelled samples of synthetic gasoline and synthetic rubber but the cost of production was not specified, which is of course the crucial point. A famous professor of metallurgy used to make this point plain to his students of the school of mines in the first sentence of his first lecture by defining his subject as "Metallurgy is the art of getting money out of ores"—instead of the conventional fashion of "the art of getting metals out of ores." In certain parts of our country petroleum gushes from the ground faster than it can be shipped and sold, and until our oil fields run dry, some years hence anyhow, we are not likely to take to making gasoline out of coal, shale or anything else. Rubber is now being grown on the British and Dutch plantations in the East Indies at less than thirteen cents a pound. Now it has hitherto been impossible to find any raw material and any factory process that would produce rubber at a lower price than this.

One reason why American experts are inclined to question this present statement of the German Chemical Trust that synthetic rubber would "soon appear on the world markets as a commercial commodity, equal to natural rubber and cheaper in cost" is because they remember that same claim was made by the same parties fifteen years ago and it did not turn out to be true. At the International Congress of Applied Chemistry in New York in 1912, Dr. Carl Duisberg exhibited with justifiable pride two automobile tires made of artificial rubber and rashly boasted that

(*Just turn the page*)

NATURE RAMBLINGS

By Frank Thone

Beaver's Little Cousin

Many persons are incredulous when they are first told that the beaver is a rodent, and more or less close kinsman of rats and mice. His size, his utterly unratlike tail, above all his astonishingly complex set of instincts, seem to set him off from these household pests even more remotely than man is set off from monkeys.

There is, however, an excellent intermediate animal to serve as connecting link between the beaver and the more familiar rodents. Nobody will deny that the muskrat is a rat, in spite of his larger size and longer fur. His teeth and his tail alike proclaim the kinship.

As his bodily build marks him an unmistakable rodent, so do his habits point beaverward. He is quite as aquatic as his larger cousin, and like him lives on a diet of twigs and green stuff at the water's edge, though he doesn't go in for quite such ambitious gnawings. Like the beaver, the muskrat builds domed winter houses out of mud and sticks, though these again are not so pretentious. Finally, just as the muskrat lives in burrows as well as in houses, so also do beavers resort to the river banks. "Bank beavers" are quite familiar animals to naturalists, though they are not played up much in most natural history books.

The muskrat has survived contact with civilization much better than the beaver, partly because of his greater multiplying powers, partly because he is less fussy about interference with his works, and partly because at first his fur was not held in very high esteem. Now, however, with the increasing rarity of the more valuable pelt-bearing animals, muskrat is coming into greater favor, both on its honest own and plucked and dyed, under a variety of trade names.

METEOROLOGY

Tropical Storms From U. S.

"Northers," severe storms of the Gulf of Mexico and the Caribbean Sea, which are most numerous in the winter months, start as cold waves in the Dakotas, and wreak their havoc in the Middle West before going to sea. This is the statement of Willis Edwin Hurd, of the U. S. Weather Bureau, who has been studying these storms and their origin. "From the very nature of the norther," says Mr. Hurd, "one recognizes the fact that it is dependent for its strength and maintenance upon the magnitude, movement, and relative positions of the high and low pressure areas crossing the United States and the waters to the southward."

Mr. Hurd describes the formation of the norther:

"A blizzard sweeps down from the northwest, the high wind blowing along the eastern wall of the anticyclone. The air is biting with intense cold and blinding with fine snow particles so thick that they obliterate all objects more than a few feet from the eye.

"Meanwhile, as the storm descends from the Dakotas, the air over the Texas plain is warm and humid, with a springlike balminess characteristic of many of the winter low-pressure areas of this region. Suddenly dark clouds, advancing slowly or with tumultuous rapidity from the northward, mark the southern squall line of the storm wave. Here comes the blizzard; but now, if we wish, we may call it a 'Texas norther.' The first blast of the squall is cold. If rain has been falling, the precipitation may quickly change to sleet or snow. This, with the sharp fall in temperature, is highly disagreeable to all living beings, even deadly if accompanied by too long exposure, while it is disastrous to tender vegetation. If there has been no precipitation preceding the burst, and none should happen to follow it, the norther may be classed as dry instead of wet.

"The anticyclone continues to advance southward, meanwhile spreading toward the east. It reaches the coast and enters upon the waters of the Gulf of Mexico. There great velocities may be developed, and squalls of even greater intensity may occur along particularly exposed portions of the coast. Meanwhile the line of frost also advances into the southland. A freeze threatens the orange groves. The inhabitants of

(*Just turn the page*)

Tropical Storms from U. S.

(*Continued from page 373*)

eastern Mexico, even of Honduras, the Florida Keys, and of Cuba, perhaps shiver under the influence of the unwonted chill. Small streams of the norther flow over the Mexican passes of the Cordilleras into the Pacific, but the great main current presses on to the southward and eastward, into the Caribbean and toward the open Atlantic, not only cooling and disturbing the eastern littoral of the upper Central American States and adjacent waters to the West Indies, but finally perhaps venting the last feeble puffs of its energy upon the harbors of Panama and even the more distant coasts of Colombia.

"Thus, for this is not merely an ideal picture, has the fierce cold wave and blizzard of the Dakotas penetrated as a norther into the Equatorial Zone."

Science News-Letter, December 10, 1927

The mass of a body increases with its velocity, but this difference is so slight that a 100-ton locomotive going 60 miles an hour will weigh only a billionth of a pound more than when it is standing still.

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Rubber From Coal

(*Continued from page 373*)

"synthetic rubber will certainly appear on the market in a very short time." But "in a very short time" after that Germany was barricaded by the Allied Armies and rubber was wanted at any cost, yet the German army automobiles had to run on steel tires.

But since the war very great progress has been made in Germany, in the manufacture of organic compounds from coal. The Bergius process for making petroleum by combining hydrogen with coal has shown sufficient promise of proving practical and profitable that the Standard Oil Company of New Jersey has invested in it. The Fischer process of making methanol alcohol from coal has cut under our process of making it from wood.

Now the products of these processes for the liquefaction of coal include various compounds out of which rubber may be made, for instance acetic acid, acetone butadiene and isoprene. So it is quite likely that some catalyst has been found which will short-circuit the process of preparation of one of the various materials and so cheapen the passage from coal to caoutchouc.

But after the chemist has done his work and produced a substance identical in composition to the natural rubber the task is still only half done, for the milk that exudes from the cuts in the rubber tree is made up of miniature globules which confine in an elastic membrane a network of minute rods and chains enmeshed in lighter liquid. When the drops are stretched the nets form a stiff lattice held in place by strong tension of the covering skin. In this crystalline structure of the natural rubber, revealed only recently by the X-ray, lies the secret of its usefulness, its incomparable elasticity and resiliency. Rubber is easy to stretch but hard to break. Hitherto none of the artificial rubbers have the peculiar cellular structure of the natural and therefore none has equalled its "stretchability." The rubber made by the Germans during the war was found satisfactory for hard rubber articles but not for soft. If now this difficulty has been overcome as well as the high price of production, the future of synthetic rubber is assured.

Science News-Letter, December 10, 1927

In the course of a day, an average tree manufactures some 20 pounds of starch.

THE NAVY'S NEW SONIC DEPTH FINDER. The operator is listening for the echo which will tell him how deep is down

SCIENCE TO EXPLORE OCEAN

(*Continued from page 370*)

U. S. Coast and Geodetic Survey is considering the installation at an early date of ultra-modern equipment at its seismological stations near San Juan, Porto Rico, and near Sitka, Alaska. San Juan is near the great Nares deep, stretching about 300 miles east and west and 100 miles north and south. It is 4,662 fathoms deep—the Atlantic's deepest point. Sitka is in the general region of the Aleutian deep, greatest in the Pacific. Rather a good scientific tie-up for America.

Other well-known ocean canyons are: One off the west coast of Mexico and Central America stretching some 400 miles long, 40 miles wide and about 3,000 fathoms deep; and one off the coast of Java, recently explored by Dr. Meinesz.

Ocean canyons align themselves close to the earth's peculiar structural formations with amazing regularity. They are found in the regions of the world's greatest and most numerous earthquakes. Undoubtedly they are connected in a definite way with mountain building. In many places near the coast they parallel steep mountains or island chains, which in reality are submerged mountains and probably are related to the formation of land mountains. Consequently seismologist and geologist alike find them of vital interest. The seismologist wants to know just how earthquakes are related to the deeps: that is, whether they are born on the inshore edge, the outside edge or in the deep's middle. Likewise, he wants to know where the slipping of rock formation—the cause of earthquakes—originally occurs, whether at the surface or far beneath. It is not impossible that these deep troughs are surface indications of lines of weakness in the earth's crust. reaching down even ten miles or more.

In their efforts to explore the ocean's great sub-strata scientists have labored under terrific handicaps. It has been impossible, and surely would be suicidal, to send submarines into the greater depths. Divers have penetrated only to depths of less than 200 feet.

But if man with all his intelligence has done little towards penetrating the far-flung depths of the sea, how about fish life down there? Can fish withstand the icy coldness, the inky blackness, the terrific pressure? It seems that they can.

Deep sea anglers claim that down as far as five miles they have found hardy members of the finny tribe. Black seems to be their unchanging color though many are characterized by luminous spots or secretions. Black bodied fellows, more than a hundred species of them, their bodies marked with round, luminous spots, are believed to be abundant. Sailor folk call them lantern fish.

And there are other luminous deep sea divers. A species known as the grenadier may be found in the deep vastness off the Continental rim between Ireland and Morocco, "where the submerged edge of the continent begins to plunge rapidly down to the depths of the Atlantic Ocean." Then there is a West Indian deep sea maneuverer whose eyes and forehead are united in a single plate. Such are a few of the many fish that swim in the depth of the seas far below the thousand foot level to which daylight penetrates.

Mention has been made of the three main methods of procedure under

(*Just turn the page*)

ASTRONOMY

Finds Naked Eye Comet

The first bright naked eye comet of recent years has been found by an amateur astronomer in Australia, according to communications received by the Harvard College Observatory, American clearing house for astronomical discoveries. The discoverer was not a professional astronomer, but an amateur star-gazer, J. F. Skjellerup, who once lived in South Africa, where he made previous cometary discoveries. Not only is the Skjellerup comet the brightest that has been seen recently, but it brings this year within one comet of the record of 1926, when eleven were observed, more than ever before. The new visitor is this year's tenth, so that it will be recorded in astronomical annals as comet j1927.

When he picked it up on Saturday, December 3, the comet was in the constellation of Norma Euclidus, or "Euclid's Rule." This is a star group that is not visible to inhabitants of north temperate countries, but at Melbourne it is nearly overhead at certain times of the year. This month, an Australian would see it low in the eastern sky shortly before sunrise, so that its poor position, even for southern countries, probably accounts for the fact that the comet reached third magnitude before it was found. On a clear dark night the keen eye can see objects about as faint as the sixth magnitude.

The comet's exact position when found, expressed in the astronomical equivalents of latitude and longitude, was 16 hours, 12 minutes and 12 seconds right ascension, and 53° 57' south declination. It had a tail three degrees long, or about six times the apparent diameter of the full moon. However, as it was moving towards the sun, it will soon be invisible even in southern countries, as the glare of that brilliant body blots out even bright comets.

Just what may happen to the comet is problematical. To determine its orbit, at least three separate observations of its position must be made. If not, the object may be lost, as has happened in the past. In the summer of 1921, Dr. W. W. Campbell, director of the Lick Observatory of the University of California, was sitting in front of his house with some friends watching the sunset over the mountains. One of the party noticed a strange bright object in the gathering dusk just after the sun had descended below the horizon. As no known object of such brightness,

(*Just turn the page*)

Comet Found by Australian

(*Continued from page 375*)

which must have been first magnitude or more, was in such a position, it is believed to have been a comet. The next night, however, it had vanished in the sun's rays, and was never seen again.

However, if all goes well with the Skjellerup comet, it should go around behind the sun, and then reappear on the other side. If that is the case, it should turn up some place in the neighborhood of Aquila, the eagle, which is now seen in the western sky shortly after sunset, though without exact data on its orbit, any prediction of its behavior is most uncertain. After that it may mount still higher in the night sky, and so perhaps the coming months will be enlivened by the presence of a brilliant comet.

If this happens it will be the first bright comet in many years. Last June the Pons-Winnecke comet became just barely visible to the unaided eye, but that was a small comet, bright only because it happened to approach very close to the earth.

Not since 1910 has there been a really brilliant comet. During that year Halley's comet came back on one of its regular visits, and then also another comet bright enough to be easily seen without a telescope appeared without warning earlier in the year. During the last century there were several bright comets, the more recent of which are still remembered by the older generation.

The first bright comet of the 19th century was that of 1811.

In 1835 Halley's comet appeared on one of its regular visits.

In 1843 a very famous comet appeared that probably belonged to the same family as comets which appeared in 1880, 1882 and 1887, all of which almost grazed the surface of the sun.

The year 1858 brought Donati's comet. In 1861 a comet appeared with a long tail through which the earth actually passed.

The years 1880, 1882 and 1887 also brought bright naked eye comets, in the same "sun-grazing" family as the one of 1843. Like that one, all were brilliant enough to be seen in daytime. These came within 400,000 miles of the surface of the sun.

The year 1892 brought Holme's comet, which was also bright. This returned again in 1899 and 1906, but then it was much fainter, so that it was only visible in a telescope. In 1919, when it was expected, it failed to appear at all.

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Science to Explore Ocean

(*Continued from page 375*)

consideration by the International Geodetic and Geophysical Union in its proposed plan. In respect to probing the deep sea troughs, the usual method has been to take soundings by means of lead weights attached to heavy piano wire. To let out some six miles of wire and pull it to the surface hundreds of times, as must be done to get an idea of the deep's configuration, is costly and time-taking.

Fortunately, echo sounding methods have been developed recently which permit depths to be determined in a few seconds. A number of repetitions can be made in a few minutes so as to make sure no error has been made. Powerful sound transmitters are needed for this and it is also necessary to employ some form of sound receiver, preferably one which determines direction accurately. This device, known as the sonic depth finder, was developed by Dr. Harvey C. Hayes, expert of the U. S. Naval Research Laboratory at Anacostia, D. C. The apparatus has been used by naval vessels in obtaining soundings in the various oceans to depths of more than three thousand fathoms.

The operation of the sonic sounder depends upon the measurement of the time that it takes a sound to travel to the ocean's floor and back again. In practice, sound impulses are sent out at various intervals until one of them agrees with the lapse of time necessary for the sound to travel to the bottom and back to the receiver.

Suppose that the vessel is passing over a bottom 400 fathoms deep. The operator sets the machine in motion so that an impulse is sent out every one and a half seconds. The first impulse will be heard in one phone of the head set while the key is closing the transmitter circuit and again in the same phone when the key closes the circuit one and one-half seconds later. Meanwhile the first impulse has traveled to the bottom and back, a total distance of 800 fathoms.

As the velocity of sound is 800 fathoms per second, the impulse is heard in the other phone of the head set one second after it was transmitted. Immediately the operator will know that the time interval to which the device is adjusted is too great and will reduce it. As the adjustment is varying continuously, the time interval can be reduced until it coincides with the lapse of time between the making of the impulse and the reception of its echo, which in this case, will be one second.

It has been proved by the U. S. Coast and Geodetic Survey, using the apparatus with special precautions, that the depth of 4,600 fathoms, or five and one-half miles, the greatest in the Atlantic ocean, could be measured readily. In a recent experiment the vast depth of the Nares deep, north of Porto Rico, was actually sounded, leaving no more doubt in the minds of scientists that the greatest ocean "deeps" can be probed with the echo sounding device.

The suggestion of the International Geodetic and Geophysical Union, that new seismograph stations be established for studying the ocean deeps, or at least that the old ones be greatly improved, should have an important bearing on future earthquake investigations. After soundings have helped determine the exact configuration of a given deep, science one day will know exactly in what part of it the earthquake occurs.

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Fresh eggs sink when placed in water, and stale eggs float, because the fresh eggs contain more water.

"Parasol" ants cut large pieces out of leaves for making nests, and march along carrying the pieces over their heads like umbrellas.

Army airplanes are now equipped with smoke candles which give forth a dense gray smoke, easily distinguished from ordinary fire smoke, so that they may signal for aid in mountainous country.

A statuette of a "golden calf" coated with pure sheet gold was found in a royal tomb in Palestine, and is believed to be some 500 years older than the calf made by the Children of Israel in Moses' time.

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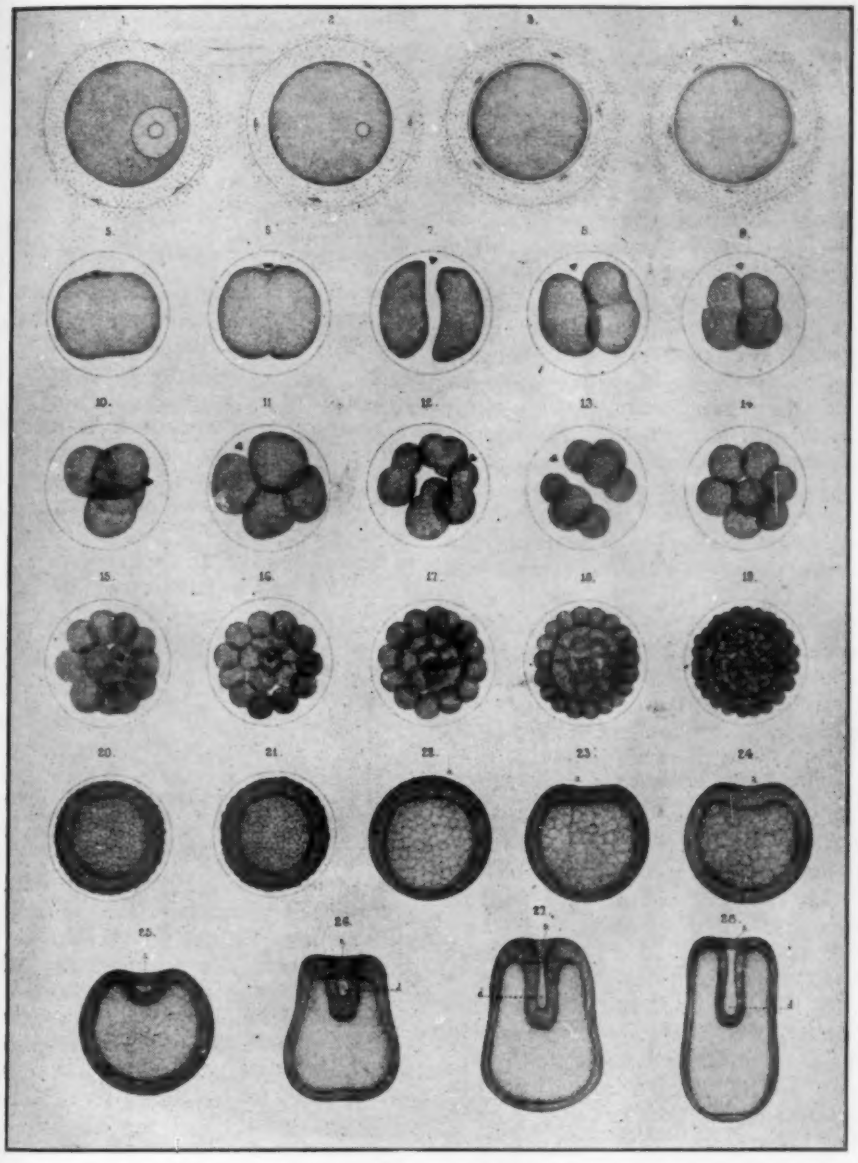
Classics of Science: Development of the Starfish



The Starfish Embryo up to and just after hatching

In the following quotation from the first chapter of Agassiz' monograph, the method of studying the development of the starfish egg up to the time of hatching is described so clearly that it is easy to repeat the procedure.

EMBRYOLOGY OF THE STARFISH, by Alexander Agassiz, Cambridge, Mass. 1864.

Difference of the Sexes

The males and females of our common species of Starfishes, Asteracanthion pallidus *Ag.* (A. vulgaris *Stimp.*?), and Asteracanthion berylinus *Agass.*, can readily be distinguished by their difference in coloring; all those having a bluish tint being invariably females; a reddish or reddish-brown color indicating a male. Among the many specimens I have had occasion to open, I have thus far never found a single exception. When cut open, so as to expose the genital organs, the difference between the males and females is still more striking. The long grape-like clusters of reproductive organs extending from the angle of the arms, on both sides of the ambulacral system, to the extremity of the rays, present very marked differences in the two sexes. The ovaries are bright orange, while the spermaries are of a dull cream-color. At the time of spawning, which is very different in the two species mentioned above, the genital organs are distended to the utmost, filling completely the whole of the cavity of the ray; the abactinal system itself being greatly expanded by the extraordinary development of these organs.

Artificial Fecundation

If we take a male and female Starfish in this state, and cut a portion of the genital organs into small pieces, we shall find that the eggs and spermaries escape in such quantities as to render turbid the water in which they are placed. Throwing these small pieces of the genital organs into shallow dishes containing fresh sea-water, and stirring the mixture thoroughly to insure the contact between the spermaries and the eggs, will be sufficient to fecundate the latter. In order to make the operation perfectly successful, some precautions are necessary: all the pieces of the genital organs, which are left after repeated stirring, must be carefully removed; there must not be too many eggs in one dish, so that the water can have free access to them in every direction. The removal of the remnants of the ovaries and spermaries is very necessary, as the pieces which remain clodded together decompose very rapidly, and endanger the safety of the egg, even when the water can be changed with the greatest facility. As soon as the fecundation is fulfilled, the water in the dishes must be repeatedly changed until it becomes perfectly clear, for the presence of too many spermaries, rendering the water milky, prevents a favorable result. It is best only to use one male and one female for the mixture in each vessel, as eggs taken from many individuals lessen the chances of success. The eggs sink to the bottom, so that the water can be poured off and changed without much danger of throwing them away. Immediately after the mixture is made, the water should be changed three or four times in succession; after that, every half hour, until the fourth hour, when an interval of two to four hours may elapse before renewing the water. As it is extremely difficult to change the water after the embryos have hatched and are swimming freely about in the jar, without losing many of them, it is advisable, before they hatch, which is about ten hours after the fecundation, to reduce the water to a minimum volume, and then simply to add a little fresh sea-water and remove the contents of the vessel to larger and larger jars. In this way the water can be maintained sufficiently pure, until the

(*Just turn the page*)

Development of the Starfish

(*Continued from page 377*)

young embryos have taken the habit of swimming near the surface, when it may all be drawn off by means of a siphon. A great deal of time and trouble will be saved by this mode of procedure, and fewer specimens lost. The jars containing the eggs should be kept in a cool place; the most convenient method of securing a low and even temperature is to place the small jars in large tubs filled with cold water.

Changes in the Egg

At the time of spawning, the eggs in the ovaries are so closely packed that they are pressed into all sorts of shapes, triangular, polygonal, elliptical; but when placed in water, and allowed to remain a short time, they soon become perfectly spherical (Pl. I. *Fig.* 1). The following numbers are the ratios of the diameters of the yolk, the germinative vesicle, and the germinative dot, the outer envelope being 1: the yolk is 0.75, the germinative vesicle 0.22, and the germinative dot 0.08. . . . .

The spermatic particles, which swim about with great rapidity on escaping from the spermaries, soon find their way to the outer envelope of the egg to which they attach themselves, beating about very violently the whole time. The particles remain embedded in the thickness of the outer envelope, and are sometimes so crowded as to form a halo round the egg (Pl. I. *Figs.* 1-4). I have not, in a single case, seen any of the particles penetrate through the outer envelope and reach the yolk itself. . . .

The first phenomenon which precedes any change in the egg is a rotary motion given to the whole egg by the constant beating of the spermatic particles; the germinative vesicle disappears (Pl. I. *Fig.* 3). The yolk has then all the appearance of an egg which has undergone segmentation, and the yolk of which should consist of innumerable small spheres. The yolk has the same granular structure previous to segmentation which has usually been considered to belong to it only after the segmentation is complete. . . . . The disappearance of the germinative dot is accompanied by a separation of the yolk from the inner wall of the outer envelope of the egg (Pl. I. *Fig.* 3); this is the first step towards segmentation, and the presence of such a marked interval would greatly facilitate the detection of spermatic particles upon the surface of the yolk, if any of them had penetrated through the outer membrane. The first trace of segmentation consists in a depression of the yolk, visible on one side of the sphere (Pl. I. *Fig.* 4), and is soon followed by a similar change on the opposite pole.

The segmentation takes place very rapidly, passing in about eight hours from the stage represented by Pl. I. *Fig.* 3 to that of Pl. I. *Fig.* 21, immediately before the escape of the embryo from the egg. The spheres in the earlier stages of segmentation are well separated (Pl. I. *Figs.* 7, 9, 11, 13). They have a centrifugal tendency, and, as they increase in numbers, arrange themselves in a shell-like envelope, which eventually becomes the wall of the embryo. This tendency is already apparent when there are not more than eight spheres (Pl. I. *Figs.* 13, 14); and as early as the stage represented on Pl. I. *Fig.* 16, where there are only thirty-two spheres, the envelope is quite prominent. The rotation of the spheres of segmentation commences before this (Pl. I. *Fig.* 6), and is entirely independent of the motion given to the whole egg by the spermatic particles; this stops soon after the rotation of the spheres of segmentation has commenced. . . .

The Embryo after Hatching

At about the end of the tenth hour after fecundation, the segmentation has been carried so far that the walls of the future embryo have become quite conspicuous, and it is now ready to hatch (Pl. I. *Fig.* 21). When the outer envelope is torn, the young rotate slowly about round a shifting axis, by means of very minute cilia placed over the whole surface; the walls are everywhere of the same thickness, and the embryo is perfectly spherical. A difference soon becomes evident; the walls thicken at one pole of the sphere (Pl. I. *Fig.* 22, *a*), and the thickening is accompanied by a flattening of the same side (Pl. I. *Fig.* 23, *a*). The next change consists in a slight depression at this flattened pole (Pl. I. *Fig.* 24 *a*); the wall bends inward forming a very shallow depression, growing deeper and deeper, until it forms a pouch extending half the length of the embryo (Pl. I. *Figs.* 25, 26, *d*, 27, *d*). While a cavity (*d*) is thus formed by the simple folding in of the outer wall, the embryo is constantly lengthening and becomes more cylindrical; the walls of the extremity opposite the pouch becoming attenuated, while, immediately round the opening of the cavity, the walls have not lost their original thickness (Pl. I. *Figs.* 26, 27, *a*). Water flows freely into and out of this cavity; currents are established, running in different directions along opposite walls of the pouch, showing this opening to be for the present a mouth; the pouch, or digestive cavity, sustains the same relation to the whole body as in the most regular and circular radiated animals, such as young Actiniae, or young Porites. The motion of the embryo, which immediately after escaping from the egg is an extremely slow rotation, increases in rapidity as it lengthens, and by the time the cavity equals half the length of the embryo (Pl. I. *Fig.* 27, *d*), the motion is much accelerated. Instead of a simple slow rotation, with scarcely any motion of translation, the latter is now quite rapid, and is accompanied by a slow rotation round a vertical axis, through the center of the longer diameter of the animal; the opening leading into the coecum is foremost during their motion.

At the end of about twenty hours after fecundation, the embryo has reached the condition just described; it is now somewhat pear-shaped, with rounded extremities (Pl. I. *Fig.* 27), having at one end an opening (*a*), leading into a pouch (*d*), which extends half the length of the cylinder. We have now the embryo in a condition which can best be compared to the embryos of other Radiates; for there is as yet, nothing of the complication hereafter introduced in the subject by the development of bilateral parts, obscuring the plan upon which the embryo is built. It is an embryo closely resembling those of the other Radiates, in which, however, the class-characters, distinguishing it from the embryos of the other classes of the type, are already developed beyond question.

Alexander Agassiz was born December 17, 1835, in Neuchatel, Switzerland, died at sea between England and America, March 27, 1910. He was the son of Louis Agassiz, who came to America in 1846. At the age of 20 he graduated from Harvard University, and published his first scientific paper four years later. In 1867 he became superintendent of the Calumet Copper mine in Michigan, which at that time was unsuccessful. He united the Hecla mine to it and started them toward the enormous prosperity they have since enjoyed. From them Agassiz received a fortune which he devoted to scientific work. He was interested in many branches of natural history, but did most of his work on forms of marine life, especially Acalephs and Echini. Beginning in 1875, he led many expeditions in the Atlantic, Pacific and Indian Oceans for the study of oceanography.

PHYSICS

Rays Make Nitrogen Glow

"Ice" of frozen nitrogen gas, which becomes solid at a temperature of 166 degrees below zero, Fahrenheit, glows with a brilliant greenish light under the influence of cathode rays. This is one of the results obtained by Prof. J. C. McClennan, of the University of Toronto, in experiments made with the cathode ray tube developed recently by Dr. W. D. Coolidge, of the General Electric Co.

Professor McClennan and his associates previously made experiments with solidified nitrogen in a vacuum tube, in an effort to determine what caused a strange green light in the aurora borealis. When the auroral light is passed through the prisms of a spectroscope, a green line appears. For a long time, the origin of this line was uncertain, but a few years ago a French scientist, Professor Vegard, claimed that it resulted from solid nitrogen when bombarded with cathode rays from the sun. Professor McClennan, however, announced at the Toronto meeting of the British Association for the Advancement of Science in 1924, that he had found the luminescence of solid nitrogen of a different color from that of the green aurora line.

In the new experiments made with the Coolidge cathode ray tube, the experimenters find that there is not only the green luminescence while the solid nitrogen is bombarded by cathode rays, but that following the turning off of the tube, there is a greenish red phosphorescence that continues for a time. This, they believe, is due to the solid nitrogen changing from one molecular form to another, the second form being the one that continues to glow. The red glow, however, is not of the same wavelength as one that Professor Vegard claimed to have discovered.

Science News-Letter, December 10, 1927

PLANT PHYSIOLOGY

Synthesis of Sugars

An approximation of the process whereby living plants produce sugar from water and carbon dioxid, using the energy of light to make the combination, has been accomplished in the laboratory of Prof. E. C. C. Baly of Liverpool University. Using the most elaborate precautions against contamination of either his materials or the glass vessels used in the experiments, the British scientist and his associates have repeatedly produced substances that pass all the chemical tests for sugars.

The first tests were made with the invisible ultra-violet light as the source of energy. In these experiments, finely powdered iron and aluminum compounds were introduced into the water. These took no part in the reaction, but acted as catalysts, or chemical go-betweens, furnishing a large spread of surface on which the chemical action could take place.

But in nature the formation of food substances by plants is carried on by the power of visible rather than invisible light. The experimenters therefore sought a closer artificial approach to natural conditions. Since leaves have colored substances in them, colored catalysts were sought for the sugar-formation going on in the glass tubes. For this purpose carbonates of cobalt and nickel, both of which are colored salts, were found useful. With these in the tubes exposed to visible light from electric lamps, the carbon dioxid and water produced the sugars quite as readily as they came into being with colorless catalysts under ultraviolet light.

Science News-Letter, December 10, 1927

PALÆONTOLOGY

To a Gigantosaurus

What incapacity was yours?
What fatal, vast ineptitude?
Your skeleton alone endures
Of all your huge reptilian brood.

Your muddy spoor was wallowed out
In fens and bogs and marshy runs.
Were your dank haunts laid waste by drought?
By flaming mesozoic suns?

Did torrid air and arid skies
Dry up each cherished swamp and slough?
Were you, for all your awful size,
Unable to evolve enough?

Were you compelled, by some dry fate,
To drag your belly all about
In your dumb way with awkward gait,
Until cool death just laid you out?

Or did some quick, insidious foe,
And not the burnished Permian sun,
Have high intent to lay you low,
Enmeshed in skeins your fates had spun?

Was it some shrewd mammalian force,
Small furry beasts with agile legs,
Who scotched the reptile at his source,
And ate your good reptilian eggs?

You cannot tell? Well, anyhow
You live no more except in dreams.
Your furry foes are talking now,
And climate is the best of themes.

—*Richard Ashman.*

Science News-Letter, December 10, 1927

ARCHÆOLOGY

Herculaneum Plundered

Italian archæologists who are laboriously excavating the buried city of Herculaneum have found to their disappointment that robbers have been there many times before them according to a report to *Art and Archæology* by Dr. David Robinson, well-known American archæologist, now in Italy.

The city was believed to be sealed, compartively intact, in its mold of hot mud poured down by Vesuvius and long since hardened to stone. But as they drill into the rock, the scientists have discovered that all through the ages tunnels have been dug by robbers. The site is honeycombed by these tunnels, showing that many works of art have been carried off in previous times, Dr. Robinson states.

"The excavations have disclosed some new houses with second stories preserved." he says. "The new methods make it possible to preserve second stories and to take casts of doors and balconies and put these in place of the last originals. In one of the new houses where the King of Italy started the excavating is a beautiful shrine of mosaic. In one room a fine pavement of large black and white tiles and in another is a multi-colored pavement. On the walls are beautiful mosaics representing a man with his mule and other scenes."

Science News-Letter, December 10, 1927

ORNITHOLOGY

Sugar For Humming Birds

Tiny bottles of sugar and water, covered with bright colored cloth, are the bait with which Miss Margaret L. Bodine of Philadelphia lures humming birds to the porch of her summer cottage in Maine where they almost literally "eat out of her hand."

The tiny birds think at first that the gaudy little vials are a new kind of flower. Once they have tasted the saturated solution of sugar and water they abandon all their former favorite brands of nectar and it is necessary, according to Miss Bodine, to refill the bottles every hour. As many as eight have visited the porch at one time, she stated.

What might be called the humming bird sweet tooth, if birds had teeth, has given this amateur ornithologist an excellent opportunity to study and photograph the minute, quick-moving birds. She has a reel of humming bird movies to her credit as well as motion pictures of purple finches and cedar waxwings.

Science News-Letter, December 10, 1927

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Science News-Letter, December 10, 1927

EUROPEAN SKYWAYS — Lowell Thomas—*Houghton Mifflin* ($5). One of the things that most impresses the present-day American visitor to Europe is the enormous development of civil aviation, travel by which, in many cases, is cheaper than first-class railroad fare. In this book Mr. Thomas tells of his own experiences in traveling 25,000 miles by air over 21 countries. It is the first complete guide-book to Europe for the traveler who wishes to travel by the most modern methods.

Science News-Letter, December 10, 1927

CALCULUS OF VARIATIONS—Gilbert Ames Bliss—*Open Court*. The first volume in the Mathematical Association's "Carus Mathematical Monograph" series now reprinted.

Science News-Letter, December 10, 1927

ANALYTIC FUNCTIONS OF A COMPLEX VARIABLE—David Raymond Curtiss—*Open Court*. Another of the "Carus Mathematical Monographs," issued by the Mathematical Association of America.

Science News-Letter, December 10, 1927

MATHEMATICAL STATISTICS—Henry Lewis Rietz—*Open Court*. The third in the useful series of mathematical monographs published for the American Mathematical Association, and made possible by Mrs. Mary Hegeler Carus. This one deals with the mathematical phases of the important science of statistics, and is intended "for readers of a certain degree of mathematical maturity."

Science News-Letter, December 10, 1927

OTHER WORLDS—O. J. Schuster—*Christopher* ($1.50). An interesting and readable account of imaginary voyages to other members of the solar system. A few illustrations would be a considerable improvement.

Science News-Letter, December 10, 1927

THE FRONTIER—Edited by H. G. Merriam — *University of Montana* (Quarterly: $1 a year). The publishers of the literary magazine of the University of Montana, desirous of giving the Northwest a voice of its own, have opened their columns to contributors not connected with the university. The Frontier is now beginning its eighth year. Special attention is given to prose and poetry bearing on the American Indian and on the history of the Northwest.

Science News-Letter, December 10, 1927

A TEXTBOOK OF PSYCHIATRY—Arthur P. Noyes—*Macmillan* ($2.60). Fifty per cent. of the hospital beds in this country are occupied by patients suffering from mental and nervous maladies, but as yet only a small percentage of those who care for the sick understand abnormal psychology. In view of these facts, a well written psychiatry text for nurses is a volume of importance. The nurse's point of view is consistently held throughout the book, since the chapters were first given as lectures to nurses at St. Elizabeth's Hospital.

Science News-Letter, December 10, 1927

YOUR WEIGHT AND HOW TO CONTROL IT—Edited by Morris Fishbein—*Doran* ($5). A valuable addition to the library of the obese. Experts in the field of nutrition and physiology warn against the pitfalls of weight reduction and prescribe sane diets and procedures for intelligent removal of avoirdupois.

Science News-Letter, December 10, 1927

REBUILDING THE CHILD — Frank Howard Richardson—*Putnam* ($2). Useful and usable advice for parents, teachers and health workers to follow in the campaign against the great disease of the American school child, malnutrition.

Science News-Letter, December 10, 1927

A DOCTOR LOOKS AT DOCTORS—Joseph Collins—*Harper* ($1). A frank discussion of the medical man that both doctors and laymen can read with profit. Written by a man who is himself a physician and psychiatrist.

Science News-Letter, December 10, 1927

SWORDFISH AND TUNA—Zane Grey—*Harper* ($6). The writer of popular fiction turns to the adventurous field of big game fishing for scope for his colorful pen. Good photographs and appealing drawings adorn this handsome volume.

Science News-Letter, December 10, 1927

HARVABD TESTS: ELEMENTARY PHYSICS, FORM A—N. Henry Black and Frances M. Burlingame—*Ginn* (60c). Teachers will find this set of tests useful in gauging the knowledge of students who have had about a year of elementary physics, and also in judging the aptitude of students for further work in this subject. The publication consists of 30 copies of the test in a cover which carries explanatory notes and a sheet for recording the grades of students taking the test.

Science News-Letter, December 10, 1927

MEDIEVAL LONDON—Gordon Home—*Doran* ($5). A fascinating account of one of the most interesting of cities in one of its most interesting periods.

Science News-Letter, December 10, 1927

PHILOSOPHY

Science and Religion

Quotation from SCIENCE AND ULTIMATE TRUTH—The Very Rev. W. R. Inge, Dean of St. Paul's—Longmans, Green (65c.).

There are some, I know, who picture to themselves Religion as retreating from one position to another before the victorious advance of science, and now preparing to die in its last ditch. That is not at all my opinion. Organized Religion is certainly in retreat, but why? I do not think that scientific discoveries have so much to do with it as is often supposed. I should say rather that Religion has in the past tried to coerce the irreligious, by garish promises and terrifying threats—both promises and threats being offered in grossly materialistic language. When these promises and threats lost their cogency it secularized itself further and announced that its object was to promote a comfortable organization of society. These irreligious appeals have failed; the irreligious no longer care for the menaces or promises of the Church, and they have no respect for the priest in politics. But the religious appeal is in no way weakened. Now, as always, the soul of man lives by admiration, hope, and love; and when these are fused in homage to the unseen but ever-present Being, the "Value of Values," as a medieval thinker called him, who exists unchanged behind the flux of phenomena, the appropriate reaction, *worship*, is set up, and the human spirit sets forth again "on its adventure brave and new," less hampered than formerly by the fragments of obsolete science and philosophy which the new knowledge has helped us to discard.

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In order to aid in catching the items that concern you and to facilitate clipping and filing, a key word in small capitals has been printed on the right of the line above each article. The key words used fit into any system of classification, whether it be a straight alphabetical file, a system of your own devising, the Library of Congress classification or the Dewey system.

Note that you can clip out any article without fear of damaging another article in which you might be interested, since editorial matter printed on the right-hand pages is backed by advertising, standing matter or a continuation of the article on the other side.

Library of Congress Classification

The classification of the Library of Congress has come into common use in the libraries of the country owing to the publication by the Government of the card index of all new books. We print below a list of the subject titles which are most used in the SCIENCE NEWS-LETTER. The full scheme of classification is contained in "Outline Scheme of Classes," issued by the Library of Congress.

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B	Philosophy.
BF	Psychology.
G	Geography, voyages, travel.
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GN	Anthropology. Somatology. Ethnology. Ethnography. Prehistoric archæology.
GR	Folklore.
GT	Manners and customs.
GV	Sports and amusements. Games.
HC	Economic history and conditions. National production.
HD	Economic history. Agriculture and Industries.
HE	Transportation and communication.
HF	Commerce.
HM	Sociology. General.
HQ	Family. Marriage. Woman.
HV	Social pathology.
L	Education.
M	Music.
N	Fine arts.
P	Philology and linguistics.
Q	Science. General.
QA	Mathematics.
QB	Astronomy.
QC	Physics.
QD	Chemistry.
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QH	Natural history.
QK	Botany.
QL	Zoology.
QM	Human anatomy.
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QR	Bacteriology.
R	Medicine. General.
S	Agriculture. General.
SB	Field crops. Horticulture. Landscape gardening. Pests and plant diseases.
SD	Forestry.
SF	Animal culture. Veterinary medicine.
SH	Fish culture and fisheries.
SK	Hunting. Game protection.
T	Technology. General.
TA	Engineering. General.
TC	Hydraulic engineering.
TD	Sanitary and municipal engineering.
TE	Roads and pavements.
TF	Railroads.
TG	Bridges and roofs.
TH	Building construction.
TJ	Mechanical engineering.
TK	Electrical engineering and industries.
TL	Motor vehicles. Cycles. Aeronautics.
TN	Mineral industries. Mining and Metallurgy.
TP	Chemical technology.
TR	Photography.
TS	Manufactures.
TT	Trades.
TX	Domestic science.
U	Military science. General.
V	Naval science. General.

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050	General periodicals
060	General societies
070	Newspapers
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110	Metaphysics
120	Special metaphysical topics
130	Mind and body
140	Philosophical systems
150	Mental faculties. Psychology
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170	Ethics
180	Ancient philosophers
190	Modern philosopers
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220	Bible
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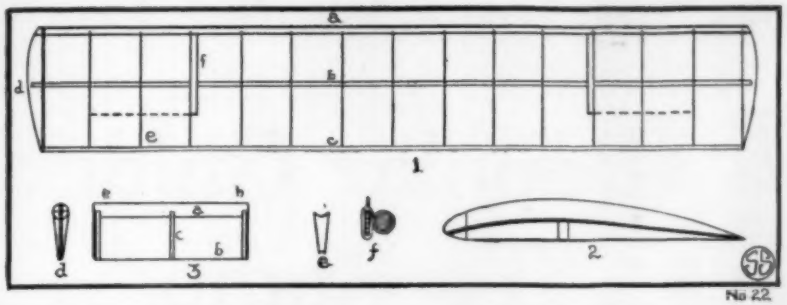

Wing of the Lindy Model

This is the seventeenth of a series of articles by Paul Edward Garber. Mr. Garber is in charge of aeronautics at the Smithsonian Institution.

The wing requires the following material:

1 balsa entering edge ¼ x ⅜ x 32½.
1 pine spar ¼ x ⅛ x 32½.
1 balsa trailing edge ⅛ x 1/16 x 32½.
17 ribs made as previously described.
2 balsa strengtheners ¼ x ½ x 4.

If ailerons are desired, add the following:

2 pine insets 4½ x ⅜ x 3/32.
2 pieces balsa ¼ square x 4¼.
1 extra rib slab (uncut).
Bamboo, Ambroid, wire, fabric, dope.

Commence by shaping the balsa entering edge "a." It is to be made with the section indicated in the front shaded portion of Figure 2, which is accomplished by planing and finishing with scraper shown in Figure 3. The center is to be marked, and at that point and at each outward point 2¼ inches away shallow saw cuts are to be made 1/16 inch wide and deep. The ribs are now assembled on the pine spar "b" 2½ inches apart from the center, care being taken to see that all are in line and true when this job is finished. They are fastened thereon with Ambroid. Each rib is now to be inserted and Ambroided in its corresponding niche in the balsa entering edge. The trailing edge "c" is Ambroided to the rear of each rib as shown in the rear shaded portion of Figure 2.

Figure 2 and Fig. 1-d show how the ends are made. The two whole ribs are slightly curved by holding them in either the heat of a candle flame or a steam flow and shaping them. When they have cooled in this position, they will be permanently set and are to be fastened with Ambroid as shown. If desired this joint may be made stronger by using a few ribbon pins pushed through from the upright rib into the end rib. Two holes are now drilled 1¼ inches from the center in the spar for attaching the wing to the fuselage. The strengtheners are cut in the bottom to admit the spar, and Ambroided in place inside the fourth rib from each end as shown at "f."

The wing frame is now complete and will impart good flying qualities to the model, but some constructors may wish to make ailerons for this wing. These are little flaps used for balacing purposes. On this type of airplane they are set in the trailing edge a little distance from the wing tip. To insert ailerons, cut the rib "e" and the corresponding one at the opposite end, at a point 1½ inches from the rear. Where the dotted line indicates insert a pine spar, 4½ x ⅜ x 3/32 inches. It is Ambroided in place. Next take the two short balsa pieces Fig. 3-a mentioned in the bill of materials and plane them round.

Make little nicks in the ends of each for the insertion of the outline piece, Fig. 3-b, which is to be made from 1/16 square bamboo. After this outline is Ambroided and wired in place make six ribs, cutting them to the shape shown at Fig. 3 c and e, 1⅛ inches long, using the scraps from Fig. 1-e and the extra rib slat as material. Ambroid these in place as shown in Fig. 3. These ailerons are now covered with silk, as described in Article 20. They are fastened to the large frame by passing a pair of wires around the balsa spar in each at g and h, crossing the ends and carrying them around the pine insert in the frame, joining the ends as shown in Fig. 3-f.

The wing can now be covered, using China silk for fabric and Ambroid for adhesive. Cut a piece of fabric 34 x 12 inches, coat the balsa entering edge with Ambroid and insert it in the longitudinal center of the cloth, rubbing over the edge to adhere the fabric. Next carry the cloth over the top to the rear edge and similarly fasten it along this. Pull the cloth tight out to the ends and fasten it there, after which all excess fabric except the large flap at the front is to be cut off. Next cover the bottom in a similar manner, and then when all adhesive has dried, dope the wing, coating the bottom side first. The dope will make the fabric adhere to the ribs and other pieces. It is obvious that the space occupied by the ailerons was not covered. The completed wing should be put carefully away where it cannot become distorted.

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INVENTIONS

The Field For Invention

Quotation from INVENTIONS AND PATENTS —Milton Wright—McGraw-Hill.

Years ago, so the story runs, a clerk in the Patent Office resigned. When asked why, he replied:

"I want to be on the safe side. Nearly all the inventions that are possible have been invented. Soon there will be no more, and this office will have to close. I want to get into something else now while I have the opportunity."

Since that time inventors and inventions have gone ahead in ever-increasing numbers. Soon the first half-millionth patent was passed, then the the millionth, then the one and a half millionth. And the significant part about the increase is this: patent number 500000 was reached in 1893; patent No. 1000000 was reached in 1911; patent No. 1500000 was reached in 1924. In other words, it took fifty-seven years (from 1836 to 1893) to produce 500,000, eighteen years to produce the second, and only thirteen years to produce the third. Nearly every year has marked a substantial increase over the year preceding in patents for new inventions.

When will the limit be reached? With equal reason one might ask, "How high is up?" There is no limit. As long as men continue to work and add to their knowledge, just so long will they be producing inventions. The field for invention is without bounds.

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Indians of New England ate some kinds of acorns.

A new kind of birch tree has been discovered in Oregon.

Egyptians of the sixteenth century B. C. used opium, peppermint, linseed, myrrh, castor oil, and turpentine in treating disease.

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